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ABSTRACT

Schools and communities will restructure as they move into the next decade. The success of this restructuring will be dependent upon access to and sharing of quality teaching and information through an expanded communication system. One of the major two-way interactive technologies is the fiber-optic cable: a delivery system that will provide access to quality instruction and a larger information base over short and long distances. Appropriately applied, this technology can be used to share outstanding teachers, increase access to postsecondary education, enhance health and welfare delivery, and support economic development. All schools and communities can use this technology to increase educational and service access through a learning community concept. In order to move Kansas forward in economic growth and to provide access of all communities and citizens to information and instruction, a fiber-optic system will be imperative. Developmental pilot projects should start immediately. (MLF)

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KANSAS COMMUNICATION AND INSTRUCTION SYSTEM THROUGH FIBER-OPTIC TRANSMISSION

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Lee Droegemueller
Commissioner of Education
Kansas State Board of Education

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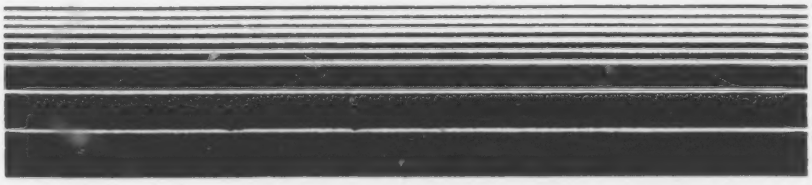


OVERVIEW

Schools and communities will restructure as we move into the next decade. This restructuring will be the result of global economic changes, demographic shifts, changes in human service delivery systems, and the continual need for training and retraining of the total population. The success of this restructuring will be dependent upon access to and sharing of quality teaching and information through an expanded communication system.

The two-way interactive video system using fiber-optic cable is one type of delivery system that will provide access to quality instruction and a larger information base over short and long distances. Appropriately applied, this technology can be used to share outstanding teachers, increase access to postsecondary education, enhance health and welfare delivery, and support economic development. This will occur by people and communities sharing resources, working and learning together in school and community clusters. All schools and communities--urban, suburban, and rural—can use this technology to increase educational and service access through a learning community concept.

This publication has been prepared for the reader in two formats. The left page provides background information on the topic. The right page is a quick digest for those who have a working knowledge of the topic.

Lee Droegemueller
Commissioner of Education

FIBER-OPTIC COMMUNICATION

One of the major two-way interactive technologies in the communication revolution is the fiber-optic cable. Fiber-optic cable contains hollow glass threads no thicker than a human hair. Through these hollow glass tubes light pulses are beamed. Fiber-optic cable produces a clear picture, is unaffected by weather, and is less subject to noise and interference than copper cable.

Fiber is a mature technology having been used for at least a decade. It is used for interoffice trunking, and now video is driving fiber to the local loop. Fiber is cost effective because it is buried underground, has low maintenance, and permits consolidation of all information delivery into one transmission medium. Dollar for dollar, fiber yields 1,000 times the bandwidth of ordinary copper wires. One pair of fiber will yield as much bandwidth as exists in all of common carrier radio frequency available for microwave. As the electronics change on each end, the channel capacity increases. It is the super highway of today's communication systems.

Fiber can transmit all signals including telephone calls, data transmission, fax (facsimile), graphics, animation, compressed television, full motion television, and high definition television. A statewide network would allow the distribution of 100 TV channels to every local cable TV system, distribute public TV to every Kansas community, and permit interconnection of public TV stations. Local communities, using fiber-optic cable two-way interactive video, could cluster together to share teachers for K-12 education, connect to community colleges and vocational schools for training and retraining, and receive undergraduate and graduate courses from Kansas universities. The same communications system could be used to enhance the business community and to network health and social services delivery systems.

A fiber-optic communication system permits cost-effective two-way communication, whereas other technologies such as broadcasting and satellites are used predominantly for one-way communication. Since an increasing number of telephone companies serving Kansas are using fiber-optic systems, for example, Southwestern Bell, AT&T, Sprint, Wiltel, this technology offers an opportunity for public and private sectors to form a partnership and to lower the cost of the system.

In order to move Kansas forward in economic growth and to provide access of all communities and citizens to information and instruction, a fiber-optic system will be imperative. Developmental pilot projects should start immediately.

TECHNOLOGICAL DEVELOPMENTS UNDERLIE THE COMMUNICATIONS REVOLUTION

- There are many developments, but the most advanced is **fiber-optic cable.**

INSTRUCTION USING FIBER OPTICS

Instruction using fiber-optic cable transmission is a form of distance learning available to enhance educational opportunities for students and teachers. The environment consists of two-way interactive instruction, utilizing audio, video, and microprocessor driven equipment. A local teacher at one of the learning sites controls the learning environment. The teacher simultaneously sees and interacts with small groups of students in classrooms at multiple locations. Audio and video signals are transmitted back and forth over fiber-optic cables to all locations simultaneously; so all participants can see, hear, and converse with one another as instruction takes place. This is different than other forms of distance learning which usually do not use local teachers and consist of two-way audio and one-way video.

Two-way interactive video enriches the curriculum and allows low-incidence and advanced classes. This technology can provide opportunities for school clusters to coordinate schedules and to share resources in response to declining enrollments, escalating transportation costs, and increasing state graduation requirements.

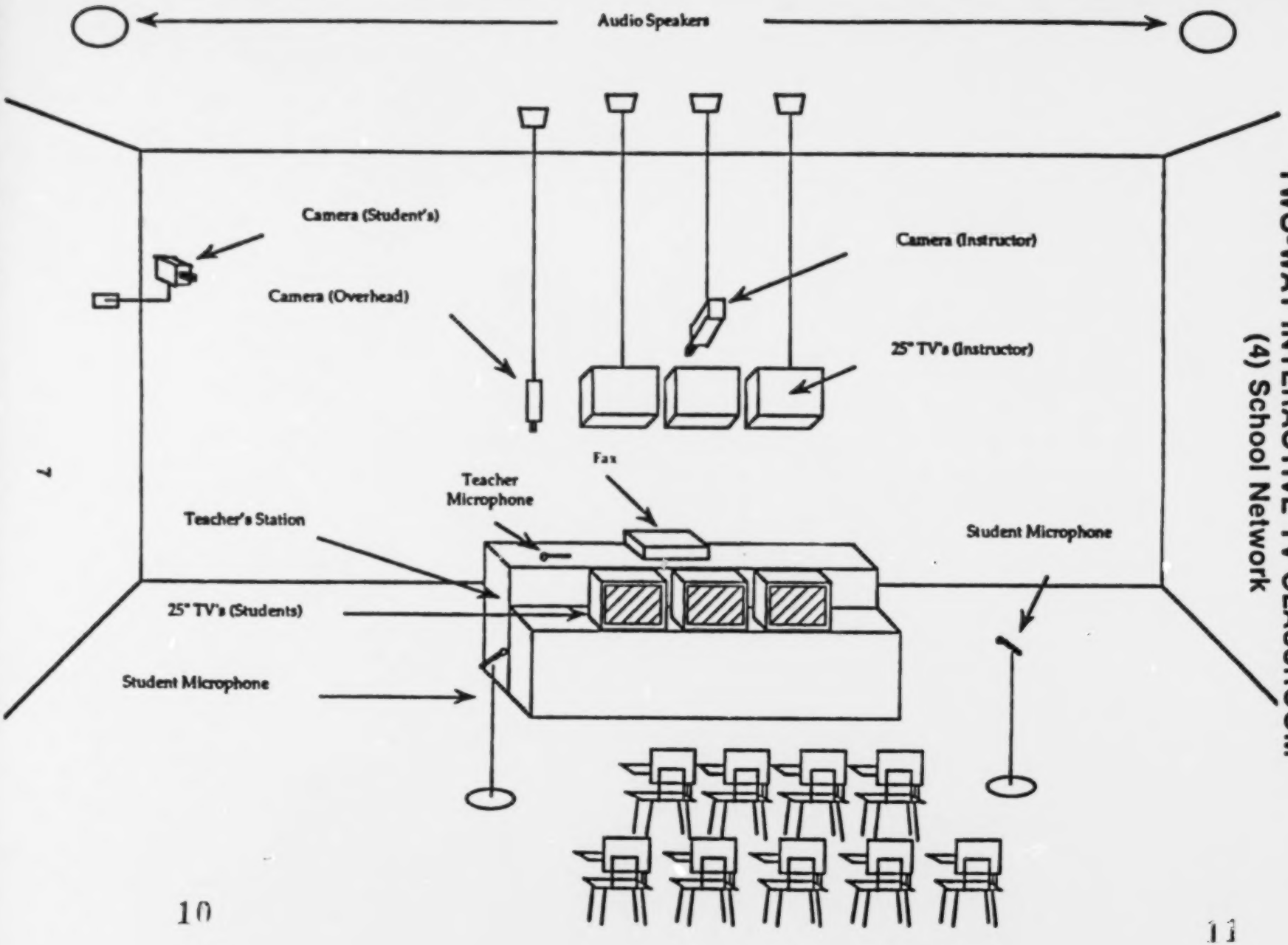
INSTRUCTION USING FIBER OPTICS

- Interactive Video System
- Human (teacher) Controlled
- User Controlled Switching (multiple technologies)

THE TWO-WAY INTERACTIVE VIDEO CLASSROOM

Two-way interactive video provides for two-way contact among the instructor and students at the home and remote sites. The classroom setting is much like any other traditional classroom using a multimedia support system. The diagram on the adjacent page represents a four-school network. The teacher can see, hear, and converse with students from the three other locations by watching the overhead televisions and using the microphone. The students can see, hear, and talk with classmates at the three other sites by viewing the three television monitors located on the table in front of their desks and using the microphones on either side of the student monitors. The classrooms at the remote sites contain two additional television monitors so that students can see the teacher and the written material and visual aids the teacher wants them to view.

The teacher can use videotapes, slides and computer-generated graphics as well as conduct lectures and hold class discussions with the students in all of the classrooms. With proper mounting of microphones and cameras, students do not need to move from their desks to be seen and heard in all of the classrooms. At each location, a video camera records the student interaction. Classes in each of the schools are small (less than ten) so an extensive amount of interaction is expected. If students need additional help, the same classroom can be used for individual tutoring before or after school. Homework and tests are faxed over the fiber-optic cable to the teacher. Assignments are sent to the students with the same technology. Several times each semester all of the students and the teacher get together at one location for discussions and socializing. The extended classroom becomes more than a vehicle for instruction and learning. It is the framework whereby students, teachers, and communities cluster, sharing resources, information, and leadership which allows them to become a new economic force.



TWO-WAY INTERACTIVE TV CLASSROOM
(4) School Network

CHARACTERISTICS OF AN INTERACTIVE VIDEO CLASSROOM

The key concept in an interactive video classroom system is maximum **interactivity.** This has been a limitation of other delivery systems in distance learning. Fiber-optic cable transmission provides the capability for a classroom to actually be extended to different locations without losing the interaction between students and the teacher or among the students in one classroom and the students in other classrooms. The instructor can see all of the classrooms and students concurrently. Students can ask questions of the teacher at any time during the class period. When the teacher responds to questions, all students can see and hear both the student asking the question and the teacher answering it. A teacher can ask a question and see all of the students before indicating which student should respond. All other students can see both the respondent and the teacher answering the questions.

A very important factor in the process of teaching and learning is the teacher's ability to determine if students are understanding the concepts or ideas presented. In order for this analysis to occur, it is imperative that the teacher be able to see the students' expressions and reactions. Without visual observation this process is extremely difficult to accomplish. Fiber-optic communications systems easily provide for two-way audio and visual communication.

Early research indicates that laboratory classes also can be conducted using this same system. Overhead cameras can focus on the students' laboratory equipment for easy supervision. However, an instructional or laboratory aid located at each remote site may be needed for safety and assistance.

The two-way interactive video system has the ability to deliver educational programs to K-12 students, postsecondary students, and adult learners; and it can offer community outreach programs to senior citizens, the homebound, and the handicapped. While the application of this technology is new and the developmental research is ongoing, it appears that two-way interactive video will be an essential part of the communities' education delivery system in the twenty-first century. Kansas urban, suburban, and rural communities can continue to meet the needs of their citizens by implementing two-way interactive video systems.

CHARACTERISTICS OF AN INTERACTIVE VIDEO CLASSROOM

- Teacher sees all classrooms and students
- Teacher sees the students who ask questions
- Students see the classmates who asked the questions
- Students see the classmates who answered the questions
- Teacher sees the students selected to answer questions
- Teacher is always in control
- There is an extended classroom feeling

LOCAL CONTROL

One of the difficulties of satellite distance learning systems is that of scheduling classes so that students will be available when instruction is being delivered. With fiber-optic distance learning systems, curriculum and schedules are determined by local teachers and administrators. In some cases a particular class is repeated during the day. Coordination and scheduling are done at the local level with the local education agency retaining control over the use of the technology system.

In a fiber-optic, two-way interactive video network, the school offers courses created and taught by local teachers using locally established curriculum. Locally developed programs better meet the needs and goals of the students and the schools using them. With this network courses can be made available every year rather than on a rotating basis. Sharing local teacher expertise and combining students from several sites make more course offerings possible.

Keeping the instructional delivery at the local level allows administrators the flexibility of scheduling, permits teachers to concentrate their efforts in their fields of expertise, and encourages parental and community involvement.

LOCAL CONTROL

- Schools determine curriculum and schedules
- There is no waiting for satellite schedules
- Local teachers are used for instruction
- Local teacher determines instruction and student activities
- Local schools can share their best teachers
- Local administrators determine school calendars

LEARNING COMMUNITIES

For some schools and communities, it may be necessary to adopt an expanded learning community concept. While schools are already heavily involved in providing numerous services such as health care, counseling, special education, food service, and drug and substance abuse support services, the school's role in a learning community concept is expanded even more.

As our smaller rural communities continue to lose health care and other social services, it is feasible that the school will be the site where many of the services can be consolidated. The schools already have nurses, psychologists, counselors, food service, and space for physical conditioning. In order to maintain some form of quality of life in small communities and/or increase the success rate of the poorly motivated, underachieving student, some of the schools will have to restructure their role in the community to provide services to the underserved.

Each community and school will have to determine what services can best be delivered by the school in order to maximize learning and to enhance the quality of life of its citizens. Some services frequently discussed in community restructuring include nursing and counseling, early childhood education, training parents as teachers, parenting support groups, drug and substance abuse counseling, teenage parenting, geriatric services, and expanded food services. Providing such services would require a high degree of coordination at statewide agency levels.

With the implementation of a statewide network for supporting fiber-optic communication, many services in a community could be consolidated. Counselors and nurses could use **two-way video communication** to access specialized consultation from distant locations such as county seats, regional and state service centers, and state universities and hospitals, thus eliminating costly, time-consuming travel. Urban, suburban, and rural populations would benefit from the expanded services and personnel growth within the school and community could be limited.

LEARNING COMMUNITIES

For some schools and communities, it will be necessary to move to the learning community concept. This concept usually includes moving or expanding health and social services to a school setting. While schools are already providing many of these services, there is usually limited support available.

- Expanding counseling resources
- Expanding nursing resources
- Offering early childhood services
  - Training parents as teachers
  - Parenting group session support
  - Handicap support systems
- Providing drug and substance abuse counseling
- Offering teenage parenting support
- Expanding health and care services
- Offering geriatric support services

COMMUNITY TRAINING AND UPDATING

In many of the smaller rural communities access to training and retraining is severely limited. The work force must be kept at its highest productive position through training and retraining. Access to training could be greatly enhanced with two-way fiber-optic communications.

At the present time police and fire department personnel must leave a community to receive professional updating. Many times these departments consist of few employees and during their absences the citizens are without fire and police services. To avoid this type of community situation, officers often stagger their training which increases the costs of transportation and instruction. With two-way interactive video, training could be delivered to these professionals within their own communities.

Health care personnel also need constant updating. Geriatric workers, nurses, Red Cross workers, and doctors could receive inservice programs, seminars, and recertification classes over a two-way video communication system. Regional centers, hospitals, and universities could serve each of these communities.

School personnel also need continuous inservice and professional development. Food service workers, school nurses, counselors, instructional aides, teachers, and administrators are required to attend professional classes. University professors and state department personnel could deliver inservice without leaving their home locations and school personnel could receive training at the local school using two-way fiber-optic communications and eliminating travel cost and loss of student contact time.

University, community college, and vocational education classes could be delivered to participants of the communities in the fiber-optic communications network. Citizens could receive the same instruction delivered by the professors and instructors on the main campuses. This instructional method would eliminate the need for additional adjunct professors and for teachers to travel off campus to instruct participants' classes. Savings would be realized to both the state and the citizens by reducing travel costs and time. Both would benefit from increased access. The potential benefits of a fiber-optic communication system as a community training tool appear to be highly significant. The students, schools, and the whole community benefit.

COMMUNITY TRAINING AND UPDATING

- First aid training
- Fire department training and updates
- Police department training and updates
- Health care training and updates
- Community college extension courses
- Vocational classes and training

SCHOOL AND COMMUNITY CLUSTERS

One of the major concepts in the restructuring of schools and communities is that of clustering communities for the purposes of sharing human and economic resources. The idea of working together or helping one's neighbor was a part of rural America a few decades ago. As the shift to high speed transportation, large farms and ranches, and a more competitive rural society evolved, the concept of working together diminished.

The fifties and sixties brought about the consolidation of small schools. Schools large enough to hire staff to provide curricular offerings in a cost-effective manner evolved. Resources were placed in bricks, mortar, and buses rather than in human development. Many communities lost their main attraction, their high schools. Some of the communities never recovered from that loss.

With fiber-optic communication systems, school consolidation is not the solution. It is possible to maximize resources by focusing on learning in schools where the students are presently located through a distance learning network. By clustering schools and communities, multiple schools can share valuable teachers and deliver instruction to students located in different communities. The best instruction can be extended to classrooms located in four to six schools in a cluster of eight to ten communities.

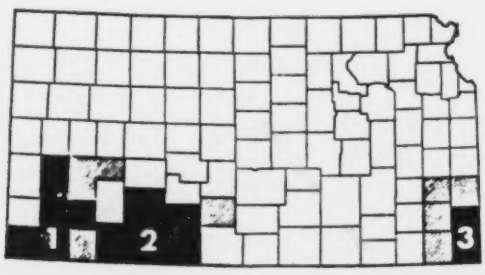
Access to education is one of the major thrusts in developing a well-trained work force and acquiring a competitive edge centered around economic development. By grouping three or four clusters together, a service area for community colleges and vocational schools could be developed. This would mean that instructors would not have to leave campus to teach (extension courses) and community members could receive high quality instruction at their local school.

The same cluster concept provided through fiber-optic networking can expand the business service area, support economic development, train and retrain work forces, and assist in expanding health and social services. By sharing resources and expanding service areas to both the private and public (interlocal education units) sectors, it may be possible to save some small communities, improve the quality of life in others, and foster economic development in the state.

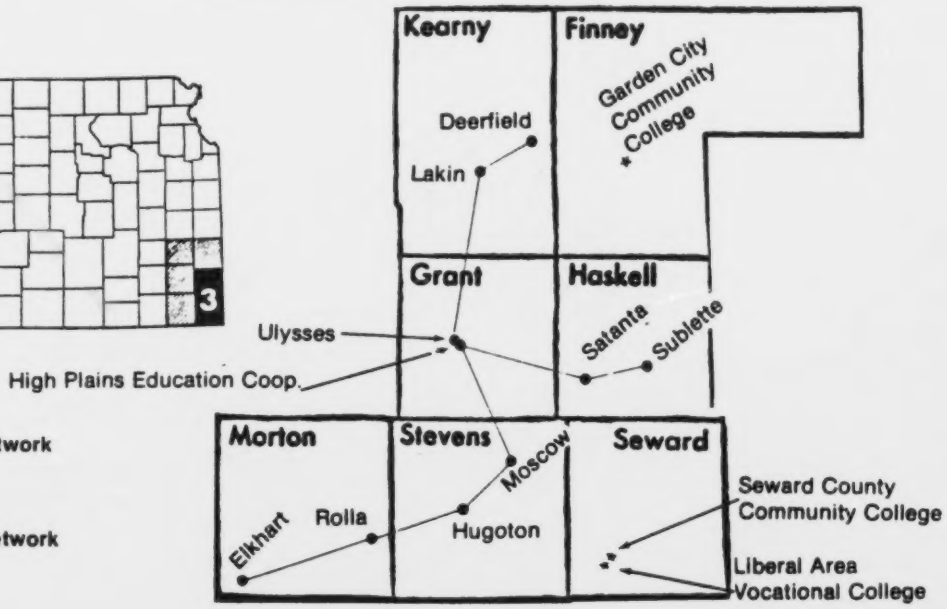
SCHOOL AND COMMUNITY CLUSTERS

- Six to ten schools or communities work together
- Courses usually offered when there is limited enrollment or specialized instruction needed
- Communities can share their best human resources
- Local schools can share their best teachers
- One business can serve a cluster of communities
- Local communities have access to information and services outside their cluster

School and Community Clusters with Fiber Optics



1. Southwest Plains Network
2. A+ Network
3. Southeast Kansas Network



BUSINESS AND ECONOMIC DEVELOPMENT

One of the major problems in the small rural communities is maintaining a large enough support base to ensure continued growth of small businesses. A healthy support base consists of a market large enough to support a competitive business environment, a population with resources to maintain the business, and a climate to keep management updated and inventories current. Due to changing demographics and mobile populations, many of the small communities and their service areas cannot support the small businesses needed to keep the community healthy.

One possible way to promote small business growth within a community is to expand service areas by clustering communities and adding a high-speed, low-cost communications network using fiber-optics. The same technologies used to carry cable TV, classroom instruction, training, retraining, and expanded health services could be used by the business cluster. New product demonstrations, training on how to use new products, and basic retail customer support could be provided to every community in the cluster by businesses located in any one of the communities. Thus one retail hardware store could service several communities by having customers select items over two-way video and providing deliveries using service vehicles that support both the public sector (regional educational service centers) and the private sector. The concept of sharing support services and cost by forming partnerships between the public and private sectors could produce savings in both sectors. By consolidating services and forming working partnerships, communities within a cluster could support the small businesses that keep their communities prosperous.

A key component to economic growth of any community is a highly educated, motivated work force. A fiber-optic communication system could bring customized short-term training to each of the communities by networking with vocational schools, community colleges, and the state universities. Business seminars on marketing programs, investment and tax strategies, as well as agriculture extension courses could be delivered in each community. Leadership training programs for community leaders and local citizens could be the basis for disseminating information and offering suggestions for community revitalization. Programs for aspiring entrepreneurs could be delivered to assist citizens in creating successful jobs and businesses using the fiber-optic communication systems. By sharing resources, working together, and consolidating services, there are many possibilities for enhancing the quality of life and maintaining the values that have made rural Kansas strong.

BUSINESS AND ECONOMIC DEVELOPMENT

- New product demonstration and training
- Retail customer support service
- Retail networking of community clusters
- Customized training for business and industry
- Seminars
  - Retail business marketing
  - Investment and tax strategies
  - Agriculture extension
- Entrepreneurial activities and support

A FIBER-OPTIC SYSTEM

By combining public and private sector needs such as telephone, data communications, fax, public television, cable TV, high-density television, instructional television, and service television, the cost of implementing a high-speed communication system is justified. In a technological information society, a comprehensive communication system becomes an important part of the state's infrastructure. It may be as important or even more important than the state's highway system in the future.

A fiber-optic network is an economically sound solution in addressing twenty-first century needs. The large capacity of fiber optics and its adaptability to the fast changing communication world makes it a wise investment for today and the future.

A FIBER-OPTIC SYSTEM

	Telephones	Data Communications	Television	Cable TV	Interactive Instruction
Public Sector					
Private Sector					

- Functional specialities
  - K-12 education
  - Special education
  - Higher education
  - Public TV
  - Vocational technical education
  - State agencies, etc.
- Success and efficiency depend on the aggregation and integration of all of these disparate needs

SUMMARY

As the next decade approaches, schools and communities will have to change. Fiber-optic and two-way interactive video technologies will play an important role in this change. New fiber-optic communication systems will allow:

- Interactive teacher-controlled distance learning
- Enhanced use of technology in the learning environment
- Expanded community training and updating
- Local control of schools and human resources
- Increased community business and economic development
- For some, the development of learning communities
- Community and school clustering